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Admiral R. H. MANNERS, Secretary, in the Chair.

On the Conjunctions of the Planets Jupiter and Saturn in the Years B.C. 7, B.C. 66, *and* A.D. 54. By the Rev. C. Pritchard, M.A., F.R.S.

In this paper the author has corrected an astronomical error, into which Dr. Ideler and several others have fallen, in attempting to establish the date of the true *Annus Domini*. The German chronologist, in his *Handbuch der mathematischen und technischen Chronologie*, has remarked, that certain conjunctions of the planets *Jupiter* and *Saturn* wholly fulfil the conditions and phenomena recorded of the star of the Magi. It asserts that of three conjunctions which occurred in the year B.C. 7, the first was of a nature sufficient to arouse the attention of the Magi, and send them on their errand to Jerusalem, and that the last of the three conjunctions was so close that, to weak eyes, the discs of the two planets might appear diffused into one, and would satisfy, moreover, the condition of being in a proper position at sunset to conduct the Magi from Jerusalem to Bethlehem.

In order to ascertain the accuracy of this statement, the author undertook the computation of the geocentric places of the two planets for the year B.C. 7, so far as any possible conjunctions were concurrent. The result is, that as regards the fact of there having been three conjunctions during the year, Dr. Ideler's statement is confirmed; but the author finds that the dates assigned by Ideler to these conjunctions are not correct; still less is it true that any such proximity occurred as to make it possible that the planets could, to any observer, have presented the appearance of a single star.

The following are the places of the planets for each of the three conjunctions, as computed by the author.

December 4, B.C. 7, at 6 p.m., Paris mean solar time.
Sun's longitude, 250° 57′ 57″·9.

	Geoc. Long. True Equinox.	Geocentric Latitude.
	° ′ ″	° ′ ″
Jupiter	345 30 5·1 ..	1 28 27·9 S.
Saturn	345 33 44 ..	2 31 8·0 S.

September 29, B.C. 7, at Paris mean midnight.
Sun's longitude, 184° 17′ 7″·6.

	Geoc. Long.	Geoc. Lat.
	° ′ ″	° ′ ″
Jupiter	347 35 5 ..	1 46 13 S.
Saturn	347 32 20 ..	2 44 18 S.

May 29, B.C. 7, at Paris mean midnight.
Sun's longitude, 64° 59′ 15″·4.

	Geoc. Long.	Geoc. Lat.
	° ′ ″	° ′ ″
Jupiter	351 1 17·3 ..	1 20 57·3
Saturn	350 59 42·7 ..	2 19 57·1

From these results it would appear that in a latitude not differing much from that of Jerusalem, on Dec. 4, B.C. 7, the planets would be about $1\frac{1}{2}$ hour east of the meridian at sunset, and would, on May 29, rise about $3\frac{1}{2}$ hours before sunrise.

The author has computed other two ancient conjunctions, one of which occurred in the year B.C. 66, and the other in the year A.D. 54. The distance between the two planets on the occasion of the conjunction in the year 66 was found to be only 55′. With respect to the conjunction of 54 A.D., the planets were too near the sun to be visible.

The results of the author's researches were confirmed by calculations executed independently at the Royal Observatory by the instructions of the Astronomer Royal.

Results of the Observations of Small Planets made at the Royal Observatory, Greenwich, chiefly in July, August, and September, 1856.

Flora.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, June 28 11 0 21·38	17 29 13·63	109 32 6·96
July 1 10 45 25·30	17 26 4·78	109 38 46·12
2 10 40 28·60	17 25 3·82	109 41 1·33
3 10 35 33·18	17 24 4·14	109 43 18·44
16 9 33 45·70	17 13 21·74	110 14 56·72

Thalia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Sept. 16 14 20 30·60	2 5 20·67	90 3 31·42

Melpomene.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Sept. 16 15 0 37·50	2 45 33·68	88 35 6·09
23 14 34 54·60	2 47 22·50	89 51 24·38

Euterpe.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, July 22 13 44 59·40	21 48 56·09	105 0 3·18
30 13 7 10·37	21 42 33·31	105 38 50·72
31 13 2 21·87	21 41 40·58	105 43 57·47
Aug. 5 12 38 7·20	21 37 4·70	106 10 13·86
7 12 28 20·52	21 35 9·54	106 20 46·83
12 12 3 47·25	21 30 15·02	106 47 17·89
14 11 53 56·71	21 28 15·97	106 57 38·67
Sept. 4 10 12 20·90	21 9 11·12	108 27 57·99
5 10 7 41·31	21 8 27·33	108 31 34·95

Metis.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, June 28 12 53 28·99	19 22 39·82	117 26 42·21
July 9 11 58 36·22	19 11 0·18	118 8 22·58
Aug. 5 9 47 2·43	18 45 31·83	119 3 16·64

Eunomia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Sept. 2 14 23 2·53	1 12 40·83	62 49 25·32
3 14 18 53·79	1 12 27·97	62 41 50·73
4 14 14 40·83	1 12 10·87	62 34 31·62
16 13 22 16·40	1 6 56·49	61 27 11·72
20 13 3 54·22	1 4 17·49	61 14 14·88
23 12 49 53·20	1 2 3·83	61 7 59·15
30 12 16 31·50	0 56 12·54	61 5 34·93

Isis.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, June 7 10 50 58·06	15 57 1·03	105 54 12·75
11 10 31 21·44	15 53 7·42	106 5 45·56
14 10 16 51·76	15 53 25·04	106 15 21·59

Fortuna.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Sept. 16 12 56 48·60	0 41 24·51	84 3 38·05
30 11 50 48·40	0 30 25·19	85 26 38·88

Astrea.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, July 3 13 32 25·85	20 21 25·87	106 6 37·66
29 11 27 32·32	19 58 42·33	107 49 16·76
Aug. 2 11 8 20·53	19 55 13·62	108 5 26·70
4 10 58 48·39	19 53 33·02	108 13 17·16
5 10 54 3·16	19 52 43·57	108 17 17·55

Irene.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Aug. 2 13 55 5·99	22 42 26·47	110 47 9·07
4 13 45 53·02	22 41 5·11	111 1 24·29
5 13 41 14·11	22 40 21·98	111 8 37·77
7 13 31 55·23	22 38 54·70	111 22 48·37
14 12 58 40·41	22 33 20·34	112 11 41·48
Sept. 22 9 54 6·0	22 1 51·21	114 51 2·31

Calliope.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Aug. 4 13 57 4·51	22 52 18·43	119 7 46·82

Circe.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Aug. 5 11 18 58·54	20 17 43·04	102 29 51·49
21 10 4 42·82	20 6 20·02	103 36 40·33
28 9 33 (38·2)	.....	104 4 41·45

Hygeia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, July 22 13 48 59·14	21 52 56·49	99 54 22·70
25 13 35 19·57	21 51 4·36	100 0 10·24
29 13 16 55·91	21 48 23·89	100 9 0·18
30 13 12 18·50	21 47 42·28	100 11 22·40
31 13 7 40·08	21 46 59·66	100 13 51·14
Aug. 2 12 58 21·70	21 45 32·86	100 18 57·92
4 12 49 1·71	21 44 4·45	100 24 18·26
5 12 44 20·93	21 43 19·45	100 27 2·08
6 12 39 39·69	21 42 34·01	100 29 51·20
7 12 34 58·36	21 41 48·47	100 32 42·39
8 12 30 16·86	21 41 2·76	100 35 32·02
9 12 25 34·9	21 40 16·63	100 38 26·52
12 12 11 28·21	21 37 57·25	100 47 22·05
14 12 2 3·52	21 36 24·12	100 53 27·41
29 10 51 59·41	21 25 16·83	101 38 46·41
Sept. 2 10 33 38·95	21 22 39·56	101 50 4·05
3 10 29 6·04	21 22 2·46	101 52 43·87
4 10 24 33·74	21 21 25·97	101 55 19·38
5 10 20 2·66	21 20 50·71	101 57 53·45
22 9 5 55·55	21 13 32·83	102 31 59·76
23 9 1 44·13	21 13 17·28	102 33 23·24
29 8 36 59·79	21 12 8·19	102 40 0·40

Themis.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Sept. 16 13 50 17·50	1 35 2·51	80 28 34·42
23 13 18 45·40	1 31 0·78	80 49 47·38

Note on the Constancy of Solar Radiation.

By Professor C. Piazzi Smyth.

In this paper the author gives the results of the discussion of a series of earth-thermometer observations, carried on at the Observatory of Edinburgh during the period comprised between the years 1838 and 1854. The thermometers were observed once a-week during this period, and are stated by their author to be admirably adapted for equalising temporary meteorological variations, and for giving good mean results. Their bulbs, filled with alcohol, are buried in the porphyry rock of the Calton Hill, at the several depths of 3, 6, 12, and 24 French feet; and the tubes are long enough to rise to the surface of the ground where their scales are placed, and may be read off to ·01 of a degree of Fahrenheit. This set of thermometers was one of several, which were established in and about Edinburgh, in 1837, for the British Association, under the care of Professor J. D. Forbes. The excellence and the completeness of the burial of the bulb of every thermometer is vouched for by the length of time, which the wave of summer heat is found to occupy in reaching each bulb in succession, according to its depth. Thus the

3-feet thermometer	has its	maximum	in	August.
6	—	—	—	September.
12	—	—	—	October.
24	—	—	—	December.

Again, from the annual range increasing with the depth, as,

3-feet thermometer,	annual range,		15°
6	—	—	9·8
12	—	—	4·6
24	—	—	1·2

The following is the mean result for each thermometer during the whole period, extending from 1838 to 1854.

t_4,	3-feet thermometer	..		46·27
t_3,	6 —	—	..	46·55
t_2,	12 —	—	..	46·94
t_1,	24 —	—	..	47·24

These results point out to a heated terrestrial centre, even by approaching so small a space as three feet. On the whole, they indicate an increase of 1° Fahrenheit for 21 feet of difference of depth.

The author, having eliminated the effects due to the internal heat of the earth, gives the annual results for each thermometer during the period to which the observations refer. He remarks

that if the numbers thus given be projected with the times, the resulting curves contain appearances of periodical waves distributed over a secular swell, with so long a period, that only a small portion of it appears in the period of seventeen years. The observations would, therefore, seem to indicate that the sun may be included in the class of variable stars.

Note on the Occultation of Jupiter by the Moon, August 19, 1856, *observed at Barrie, Simcoe County, Canada West, in West Longitude* $5^h\ 18^m\ 20^s \pm$, *and North Latitude* $44^\circ\ 25' \pm$. By Charles B. Chalmers, F.R.A.S.

(*Communicated by the Rev. W. R. Dawes.*)

"At $12^h\ 50^m$, local mean time, the moon was approaching the planet, three of whose satellites were visible, the third and fourth being to the west, and the second to the east.

"I lost sight of the three satellites some minutes previous to the occultation, in consequence of the haziness which the atmosphere presented in the neighbourhood of the moon; but the planet was as bright when in apparent contact with our satellite as he was ten minutes before. The planet did not appear elongated or distorted in any way; and the only circumstance worthy of being noted about the immersion was this, viz. it seemed to me (if I may so express myself) as if the moon wished to repel any contact:—in fact, the planet appeared stationary for some seconds, and yet to my eye was perfectly round. This illusion I attribute to refraction; but I should like to have the opinions of more experienced astronomers expressed through the medium of the *Monthly Notices*.

"Shortly after the immersion, the atmosphere became clear, with the exception of a halo round the moon, at a distance of about 12°; that is, the halo was at that distance, and about 2° in breadth. When the two satellites (the third and fourth) reappeared at the dark limb, they were, as well as I could judge, as bright as if the moon had been absent altogether; and the planet at its immersion presented a very beautiful appearance, forming a very fine and elongated crescent, much more so than one would have expected to see; but there was no diminution in its brightness. Clouds intervened before the last satellite (the second) reappeared."

The telescope employed was a very excellent $3\frac{1}{2}$-foot refractor, by Mr. G. Dollond, with a $2\frac{3}{4}$-inch object-glass: power 60. Time of the phenomena not accurately noted. The belts of *Jupiter* were very distinct, especially the higher or southern one.

Micrometrical Measures of Antares. By Thomas Maclear, Esq.

(*Letter to the Astronomer Royal.*)

"I received the other day No. 3, vol. xvi. of the Royal Astronomical Society's *Notices*, wherein you remark that the small elevation of *Antares*, even when on the meridian, and the consequent confusion of image, make it impossible to see it as a double star in your latitudes, &c.

"Here even, when the definition is bad, the *secondary* cannot be distinguished; but in fair definition its relation to the *primary* can be measured with great precision; bearing in mind, with respect to the distance, that they are nearly on the same parallel, therefore, without the aid of a good *driving* clock, and because their magnitudes are very unequal, the distance measurement would be difficult. I have no reason for complaint against my *driving* clock.

"The measures on the next leaf exhibit a trace of change in the angle and distance since the year 1849.

"Excepting the first series, in the year 1849, each partial set of measures consists of ten, the observations being recorded on the well-known forms of days gone by. I send the last (No. 232) to show how this binary may be worked here during good definition.

"The last ten measures of α^1 α^2 *Centauri* were on May 22d, angle 306°·5, distance 3″·96 (perhaps a little too great). In fact, the distance has altered little for a long time, but the angular motion is increasing.

Antares.

Angle of Position and Distance of the Components.

Epoch.	Angle.	No. of Obs.	Distance.	No. of Obs.	
	°		″		
1849·640	276·59	35			*Primary*, orange-red.
1849·663			3·718	20	*Secondary*, deep ultra-marine.
1849·679			3·693	80	
1849·680	276·20	80			
1850·211	275·31	80			
1850·257	275·37	20	3·519	20	
1850·371	273·80	30	3·539	30	
1851·372	274·26	10	3·598	10	
1852·556	273·86	20	3·598	20	
1855·353	273·68	10	3·603	10	
1856·389	273·81	10	(3·282)	10	Indifferent definition.
1856·478	273·48	20	3·453	20	

8½ feet equatoreal, and power 464 always employed.

Royal Observatory, Cape of Good Hope,
1856, *June 18th.*

The following are the individual measures in position and distance corresponding to No. 232, which were forwarded by the author:—

Date, 1856, June 10.

Power.	Position. ° ′	Power.	Distance Rev. Pts.
464	258 45	464	+30·013
	16		·019
	40		·006
	45		·006
	34		·010
	23		·054
	26		
	16		−30·270
	24		·272
	36		·275
			·280
Mean	258 30·5		·280
Zero for position	+15		·377
	=273 30·5	Mean	+30·0108
	=273·508		−30·2754
		Divide by 2	·2646
		Parts	= ·1323
		Seconds	= 3″·449

N.B. The plus and minus readings to be taken alternately.

Longitudes derived from Lieutenant Dayman's Observations of the Solar Eclipse of 1854, *Nov.* 19. By the Rev. R. Main.

(*Letter to Captain Washington, R.N.*)

"A short time ago I forwarded to you the longitude results derived from Lieutenant Dayman's observations of occultations of stars by the moon made on the coast of Africa. I am now able to send you the results for the longitude of Port Elizabeth, Algoa Bay, from his observed times of the beginning and end of the solar eclipse of 1854, November 19.

"Assuming that the diameters of the sun and moon used in the calculations are correct, and that the relative error of the sun and moon's N.P.D. produces an insignificant effect (which is the case in this instance), the longitude east derived from the time of commencement of the eclipse, is

$1^h\ 43^m\ 6^s{\cdot}01 + 1{\cdot}757 \times$ excess of corrections in arc of moon's assumed R.A. above corrections of sun's R.A.

"We have no observations very near the lunar conjunction

of Nov. 19, 1854, to enable us to determine accurately the error of R.A. of the moon; but from observations of other lunations, I have reason to believe the errors to be very considerable, and I think we may assume $-25''$ to represent pretty well the corrections in arc due to the relative errors in R.A. of the moon and sun.

"The longitude will then be

$$1^h\ 43^m\ 6^s{\cdot}01 - 1^s{\cdot}757 \times 25 = 1^h\ 42^m\ 2^s{\cdot}208 \text{ east.}$$

"Similarly the resulting longitude from the observations of the end of the eclipse is

$$1^h\ 42^m\ 47^s{\cdot}82 - 1^s{\cdot}106 \times 25 = 1^h\ 42^m\ 20^s{\cdot}17 \text{ east.}$$

"*Royal Observatory, Greenwich*, 1856, *July* 15."

A gentleman has for disposal an achromatic refractor, by the elder Tulley, having a clear aperture of $3\frac{1}{4}$ inches, and a focal length of 32 inches. It has a triple object-glass, and is provided with two terrestrial eye-pieces—a large diagonal, with four powers—six celestial eye-pieces, of the respective powers of 40, 60, 84, 132, 232, 288, and a finder. It has vertical and horizontal movements, and is mounted on a solid but very unworthy tripod stand. It performs satisfactorily all the more important tests, and is in perfect order.

The telescope belonging to the late Dr. Miller of Whitehaven is now for sale. It is an achromatic refractor of admirable definition, mounted equatoreally, in the German style, and driven by clock-work. The aperture of the object-glass is $4\frac{1}{10}$ inches and the focal length 69 inches. There is an ample supply of eye-pieces and coloured glasses, and a parallel wire-micrometer of beautiful workmanship, by Simms, with powers ranging from 50 to 500.

The telescope is by Cooke of York and is nearly new. It will divide ζ *Boötis*, ζ *Herculis*, λ *Ophiuchi*, &c. Further particulars, price, &c., may be known by application to Isaac Fletcher, Esq., F.R.S., Tarn Bank, Workington.

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Page 152, line 18, *for* objections, *read* observations.

— 152, — 30, *for* π^2 *Andromedæ*, *read* γ^2 *Andromedæ*.

— 173, *Lætitia*, April 19, App. N.P.D., *for* 78° 49′ 47″·13, *read* 77° 49′ 45″·31.

— 185, line 13 from top, *for* zinc, *read* time.

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